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THE STUDY REGARDING THE INFLUENCE OF CUTTING PROCESS ON THE SURFACE ROUGHNESS AT THE TURNING OF THE POLYAMIDE PA 66 MOS_2

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Abstract As it is known, the surface condition has two constituents: the dimensional accuracy and roughness of the machined surface. In this study it is presented only the condition of the machined surface from the roughness point of view.

This paper present a study regarding the obtaining by experimentally way of the models who describe the dependence between the machine surface roughness of a blank of polyamide PA 66 MoS_2, composite material proceeding from ERTA Company, and the parameters of cutting process.

1. Introduction

As it is known, the surface condition is set off by the dimensional accuracy and by the roughness of the machined surface. Between the two constituents of the surface condition, in this study it is presented only the roughness of the machined surface.

As it results from the title, the processing operation is the turning, and particularly it is talked about the straight turning (of rough cutting and of finishing). The processing operation had in view is the turning, and particularly it is about the cylindrical turning (rough turning and finish turning).

As regards the parameters of turning, this study presents the influence of: the cutting speed, v [m/min], the work advance, s_1 [rot/min] and the cutting depth, t [mm].

2. EXPERIMENTAL

Polyamide PA 66 MoS_2 is a material based on a polyamide PA 66 to whom it was added 1% molybdenum disulphide (MoS_2).

The material used features be presented in table no.1.

Table no.1: Mechanical properties of the materials used [1]

Properties	Unit	PA 66 MoS_2
Density	g/cm^3	1,16
Breaking strength	MPa	78
Breaking elongation	%	25
Resistance to shock	KJ/m^2	3,5
Ball test hardness	N/mm^2	160

The experimental assays established in basis of a research plan having as input variables the parameters of the cutting conditions (table no.2), were performed in the following conditions:

- turning tool (lathe tool) for each processing method (roughing/finishing), with the geometry presented in table no.3;
- the machine – tool: normal parallel lathe MSZ 5022;
- the measuring instrument: Surtronic 4;

- the processing were made without cooling;
- the ambient temperature: 20^0C;
- the semi-products utilized had a diameter of 50 mm.

Table no.2: Parameters of the cutting conditions

Processing \ Parameters		Roughing	Finishing
Cutting depth, t [mm]	Minimum	0,4	0,1
	Medium	0,7	0,18
	Maximum	1,2	0,3
Advance, s_l [mm/rot]	Minimum	0,4	0,1
	Medium	0,6	0,15
	Maximum	0,9	0,225
Cutting speed, v [m/min]	Minimum	29,83	117,75
	Medium	41,605	166,42
	Maximum	58,875	235,5

Table no.3: The cutting tool used

Processing \ Parameters		Roughing	Finishing
Material	mm	Rp3	
Clearance angle	^{0}	8 [2,3]	
Rake angle	^{0}	30 [2,3]	
Nose radius	mm	1	
Entering angle	^{0}	45	75
End cutting edge angle	^{0}	45	5

The mathematical pattern from which we started is of the type:

$$R_a = A_0 \cdot v^{A_1} \cdot s^{A_2} \cdot t^{A_3} \quad [\mu m] \qquad (1)$$

where: $A_{0\ ...\ 3}$ – coefficients.

3. RESULTS AND DISCUSSIONS

To emphasize this influence i have started from a orthogonal centered experimental plan of the type 2^3, in which the independent variables are: the cutting speed, v [m/min], the work advance, s_1 [mm/rot] and the cutting depth, t [mm].

The data obtained in the wake of the experimental researches, in the above mentioned conditions, led, in base of technical literature [1], [2], [6] and [7], to the determination of some empirical relations between the roughness of the machined surface and the input parameters of the processing process.

These relations are:

- for the longitudinal rough turning:

$$R_a = 44,67 \cdot v^{-0,106} \cdot s^{0,524} \cdot t^{0,051} \ [\mu m]; \qquad (2)$$

- for the longitudinal finish turning:

$$R_a = 3,01 \cdot v^{-0,177} \cdot s^{0,089} \cdot t^{0,076} \ [\mu m]; \qquad (3)$$

On base of the relations (2) and (3) there have been raised graphics (figures 1, 2, 3 and 4) to emphasize the dependence between the roughness of the machined surface and the input parameters of the processing process.

Table no.4: Experimental plan

Exp.	Normative values of the independent variables		
	v	s	t
1	-1	-1	-1
2	1	-1	-1
3	-1	1	-1
4	1	1	-1
5	-1	-1	1
6	1	-1	1
7	-1	1	1
8	1	1	1
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0

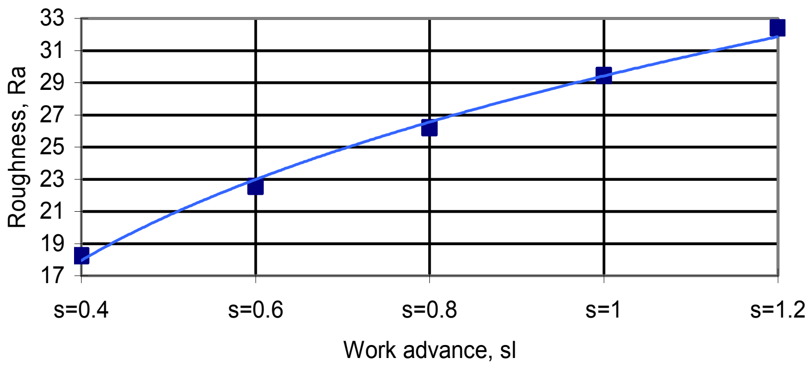

***Fig.* 1: Dependence between Ra, [µm], and s, [mm/rot], (v, t = const.), for roughing**

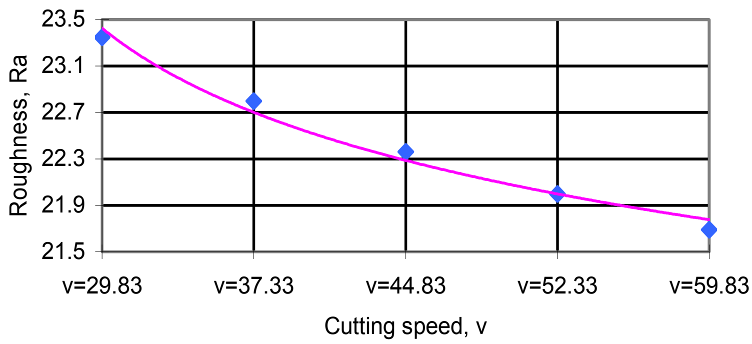

***Fig.* 2: Dependence between Ra, [µm], and v, [m/min], (s, t = const.), for roughing**

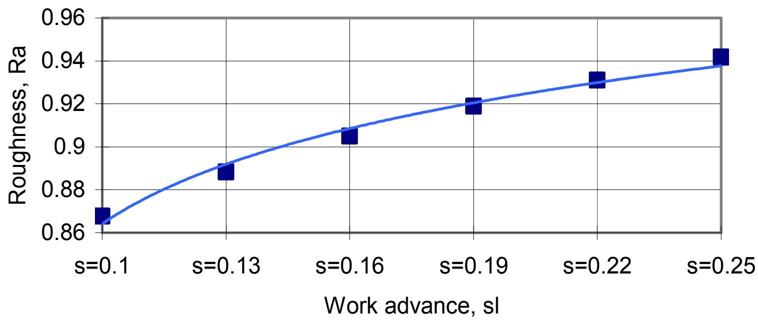

***Fig.* 3: Dependence between Ra, [µm], and s, [mm/rot], (v, t = const.), for finishing**

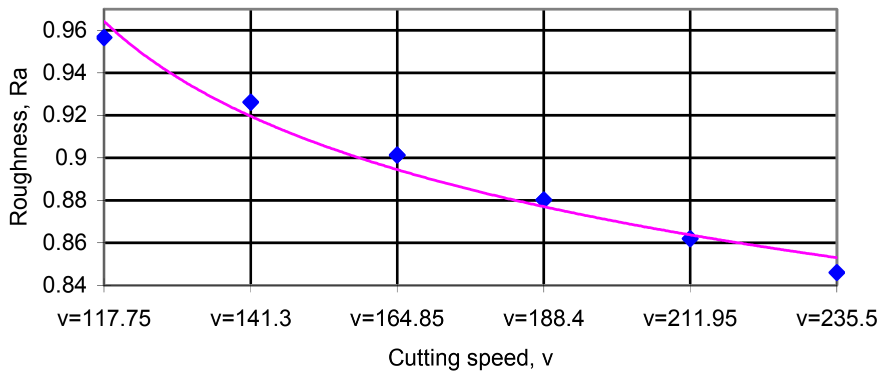

***Fig.* 4: Dependence between Ra, [μm], and v, [m/min], (s, t = const.), for finishing**

It can be observed, from these graphics, that the biggest influence on the surface roughness, between the parameters of the cutting conditions, has the work advance, s_l, followed by the cutting speed, v, and, with a very small influence, the cutting depth, t.

4. Conclusion

After the results we draw the following conclusions:

- in the case of the dependence between Ra and s, it's found out that if we measure the gradient of the right line, the variation of the roughness in terms of the variation of the forward flow is large (gradient of the right line is 87^0 in case of the roughing turn and of 4^0 – in case of the finishing turn);
- in the case of the dependence between Ra and v, it's found out that if we measure the gradient of the right line, the variation of the velocity is lower than the variation of the roughness in terms of the variation of the forward flow (gradient of the right line is 25^0 - in case of the roughing turn and of $0{,}1^0$ - in case of the finishing turn, in which case we can consider that the roughness it is not influenced by the variation of the cutting speed).

5. References

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